PROGRESS REPORTS
FROM
EXPERIMENT STATIONS

SEASON 1955-56

NORTHERN NIGERIA

PUBLISHED BY
THE EMPIRE COTTON GROWING CORPORATION,
12 CHANTREY HOUSE, ECCLESTON STREET,
LONDON S.W.1.

1957

COMMONWEALTH MYCOLOGICAL INSTITUTE
21 FEB 1957

PROGRESS REPORTS FROM EXPERIMENT STATIONS

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NORTHERN NIGERIA

PROGRESS REPORT FOR THE SEASON 1955-56

Planting Period: June to August.
Picking Period: November to February.
Close Season: April to June.

General Introduction.

BY

H. E. KING and M. A. CHOYCE

Season and General.

The commercial crop (152,000 bales of 400 lb.) was the second largest ever recorded. It was nevertheless disappointing, since hopes had been entertained that it would be far larger. With a substantial increase in the amount of seed issued, prospects at planting time were bright and remained so until September, with good reports of early growth from most areas.

Further development, however, was unsatisfactory and the yields from the main producing areas were well below those of the previous season. Crops in Niger, Bornu and Gombe Division of Bauchi Province did well but were unable to compensate for the drop in Katsina, Sokoto and Zaria.

The weather must be blamed for the poorer crops in these Provinces. It was characterized by excessive rainfall in August and September, followed by an early and unusually abrupt onset of the completely rainless and cold weather, with extremely low humidities, of the Northern Nigerian winter.

The monthly figures for meteorological readings at Samaru are given in Table 1. From this it will be seen that the rainfall for the three months, July, August and September, was much above average and far more than is needed to nourish a young crop of cotton. Severe waterlogging resulted in most parts of the Samaru farm and at Daudawa.

The table also shows that the November means for humidity and air temperature were below those of last season. In fact, the fall in the daily readings, which marks the onset of the Harmattan, was about three weeks earlier than last season. In consequence, the relatively humid but warm and sunny period which usually occurs between the end of the rains and commencement of the Harmattan was curtailed. The duration and character of this period is believed to be of outstanding importance in the development and fruiting of the cotton plant although studies directed to confirming (or disproving) this have not yet proceeded far.

TABLE 1.

SUMMARY OF METEOROLOGICAL DATA AT SAMARU UP TO 1955.

Month	*Rainfall*		*Days Rain*		*Relative Humidity* (1)				*Air Temperature °F (Screen)*				*Sunshine* (2) *Daily Mean* (*Hours*)		*Open Pan* (3) *Evaporation* (*Inches*)	
	1955	1924 to 1955 Av.	1955	1938 to 1955 Av.	1955 a.m.	1955 p.m.	1938 to 1955 a.m. Av.	1938 to 1955 p.m. Av.	1955 Max.	1955 Min.	1938 to 1955 Max.	1938 to 1955 Min.	1954	1955	1954	1955
January	0·00	0·00	0	0·0	21·5	17·0	31·1	13·9	85·2	58·8	88·8	57·7	9·8	*8·8	7·04	6·66
February	0·00	0·06	0	0·4	13·5	9·8	28·2	12·7	90·9	61·6	91·7	60·6	9·4	9·9	7·31	7·98
March	0·03	0·38	2	1·1	28·6	15·6	36·8	15·5	95·9	67·6	96·2	67·2	8·6	9·2	8·09	9·41
April	1·47	1·24	5	3·1	49·6	30·7	56·5	26·6	95·0	70·7	97·4	71·3	7·7	6·9	6·27	7·69
May	2·98	5·35	7	11·0	62·1	43·8	75·4	47·1	92·2	69·8	91·7	70·2	7·7	8·4	5·87	8·20
June	7·19	6·38	19	12·8	78·6	65·2	83·5	59·5	85·8	67·3	88·0	68·2	8·3	7·4	5·50	5·23
July	12·46	8·90	22	16·2	80·4	67·0	88·0	68·9	84·1	66·5	83·6	67·4	5·2	6·2	6·11	4·50*
August	13·11	11·90	21	20·7	80·6	69·3	90·0	72·9	83·4	66·4	82·0	67·0	3·4	5·2	4·86	4·36
September	13·05	8·81	15	16·7	80·2	66·7	86·8	65·0	83·6	66·2	85·0	66·7	7·2	5·7	5·07	5·10
October	2·68	1·39	7	4·7	66·3	49·1	78·6	45·7	88·0	65·9	89·1	65·5	8·1	8·4	5·18	5·86
November	0·00	0·05	0	0·3	23·2	19·1	44·2	21·8	87·7	57·6	90·1	60·7	10·0	10·2	6·46	7·19
December	0·00	0·01	0	0·0	22·9	19·1	30·9	16·2	84·7	54·7	88·1	57;8	10·1	10·0	6·82	6·90*
Totals	52·97	44·47	98	87·0	—	—	—	—	—	—	—	—	—	—	74·58	79·08
Means	—	—	—	—	50·6	39·4	60·8	38·8	88·0	64·4	89·3	65·0	8·0	8·0	—	—

(1) Since 1953, observations taken at 0900 hours and 1500 hours G.M.T.
Before 1953, observations taken at 0800 hours and 1300 hours G.M.T.

(2) Campbell-Stokes sunshine recorder.

(3) From tank 6′ × 6′; not corrected for errors due to splash.

*Observations on 29 days only

Observations showed that flowering commenced late and boll setting was poor and erratic without a well-marked flush. In consequence the crop was late and the final yield was attained by the retention and maturing of bolls from flowers produced sporadically well into December.

These difficult fruiting conditions magnified the usual plant to plant and plot to plot differences in cropping and also produced some substantial modifications or even reversals in the relative yields of strains and of plots subjected to differing treatments.

The general incidence of insect pests at Samaru did not appear notably higher than usual but there is evidence that more loss of crop was caused by insect damage, perhaps because the normal powers of recovery of the cotton plant were already taxed to the limit.

It is probable that this assessment of the incidence and effect of insect pest damage applies also to the commercial crop, with two exceptions. Damage to crops at Kontagora and Mokwa was far heavier and in parts of Northern Katsina a severe but localized outbreak of pink bollworm did notable damage to part of the crop.

Similarly, bacterial blight (*Xanthomonas malvacearum*) was not conspicuously more in evidence than in most seasons but may have done rather more damage. The protection afforded by seed disinfection appeared to result in some increase in yield in an experiment at Samaru, in contrast with the results of the previous season.

In spite of the difficult conditions discussed above, the final yields at Samaru, after a long drawn out picking period, were not in general greatly below those of last season. Yields of 600-800 lb. of seed cotton per acre were obtained from the various multiplication plots; experiments (less well treated) gave 450-600 lb. There was certainly no universal depression comparable with that shown by the commercial crop of Zaria and Katsina Provinces.

At other stations also the yields on departmental farms were not heavily depressed and in some stations were indeed above last season's (e.g. Maigana). At Daudawa yields up to 650 lb. of seed cotton per acre were recorded in fields growing the first stages of seed multiplication of Samaru 26J.

A general conclusion which may perhaps legitimately be drawn from the season as a whole, over the greater part of the cotton belt, is that the weather was such that failure to follow the rules of good cultivation incurred a heavier penalty than usual. In most seasons a large proportion of the crop is planted far later than the optimum date. This renders it peculiarly vulnerable to seasonal fluctuations in weather and is beyond doubt the biggest single factor holding back production.

Staff, Buildings and Land.

Mr. Lawes returned from leave on 12th July 1955. Mr. King left Samaru on 19th July, and, after leave in the U.K., proceeded to Uganda for conferences and discussions over the period 2nd to 20th October, returning to Samaru on 25th October 1955.

Mr. Choyce also visited Uganda for these discussions, being absent from Samaru over the period 9th to 25th October. He proceeded on leave on 2nd March 1956. Mr. Krzywon took leave from 3rd May to 13th September 1955, and Mr. Emsley from 29th May to 10th August.

Mr. H. M. Parker reached Nigeria on 17th January 1956, to take up his work as plant pathologist. He was housed temporarily in Zaria pending availability of housing at Samaru and was found a corner in the Botanical Museum in which to work.

The shortage of African staff became still more acute during the season. A number of lines of work had to be discontinued and others have dropped into arrears in consequence of the staff position.

Plant Breeding.

BY

H. E. KING and D. A. LAWES

Hybridization.

The programme of hybridization, briefly referred to in last season's report, was continued and the required crosses were successfully made. No details of this work can usefully be presented at this stage. It is of interest however to note that some hybrid single plants, showing presumably a very substantial degree of hybrid vigour, were able to yield as much as $\frac{3}{4}$ lb. of seed cotton per plant in this difficult season.

An experiment was carried out to give some rough guide to the general level of natural outcrossing which takes place at Samaru. For this several different marker types were imported. Preliminary results suggest that the amount of outcrossing is high. It is fully realised that these results suffer from the objection that crossing between widely different types is a poor guide to crossing within a single strain. A start has, therefore, been made in breeding a local marker type differing from 26C only in the possession of a marker gene.

Replicated Progeny Row Tests.

Two large tests of progenies were carried out. The first followed what has become the established design here, a balanced incomplete block design accommodating 49 treatments in eightfold replication with a plot size of 1/1000 acre (9 stands of cotton, one plant per stand at 18″ spacing on a 3 foot ridge).

This experiment showed a high standard of precision for so small a plot size, the coefficient of variation being only 17%. The magnitude of the differences between progenies was, however, disappointing. It was concluded that the season was against the expression of real differences; the 26C/49160-23 progenies (which comprised one third of the total in the test) did surprisingly poorly.

Nevertheless, significant differences in plant characters were brought out and useful comparisons of the importance of the separate components of yield were possible. Lint per seed appeared the most influential single character; bolls per plant were of more importance than seeds per boll.

The second of the two trials was much larger and on less orthodox lines. It contained 120 progenies each replicated only four times but with each plot accompanied by a control line of a standard strain. This enabled analyses of covariance to be employed to adjust observed yields. The coefficient of variation after this adjustment was no larger than that of the much smaller test described above (viz. 17%).

In this test wide differences in yield occurred: the progenies were all derivatives of the line 26C/479-25 and the test was most useful in establishing that significant differences existed within this material.

Small Bulks Test.

Forty-nine small bulks of material from the previous season's progenies gave interesting but rather disappointing results in a replicated test. This was in the form of a balanced incomplete block design with 8 replications and plot size of 1/200 acre; a plot contained 48 stands at 18″ spacing on a 3 foot ridge. Planting was in early July.

One-third of the selections under test were derived from 26C/49160-23, material with a reputation for high yield with notably early cropping and very good lint quality. It appears that the season was unsuited to this type; almost all these derivatives gave poor yields relative to 26C and 26J. This result was in keeping with the behaviour of 26C/49160-23 BCP in the strains test and some of the district variety tests (see later).

There were some quite severe losses of seedlings in a number of lines in this experiment during the early weeks of growth. These were associated with difficult growing conditions (excessive rainfall and partial waterlogging) but were very irregularly scattered and strongly suggested differing susceptibility of related lines of material to some specific but unidentified cause of seedling mortality. Final stands of several lines were so reduced as to render their yield figures useless. This is the second season in which sporadic losses of this nature have occurred; plans have been made for an investigation into the cause.

Strains Test.

Twenty-one strains, chiefly of 26C derivation but including some introduced types, were tested in a balanced incomplete block design with ten replications. The plot size, spacing and planting date were as for the small bulks test described above. Yields were high, the control 26C giving over 600 lb. of seed cotton per acre, but as a comparison of strains the test was disappointing. Differences between the various 26C derivatives were in general small and out of keeping with their previous history.

It seems probable that the conditions of growth interfered with the expression of varietal characteristics displayed in a more normal season, obscuring the differences between related types and reversing some of the comparisons between those of more widely different origin and fruiting characteristics. MU8A, for instance, normally a substantially higher yielder than 26C, was this season significantly lower yielding. This did not appear to be due to its known greater susceptibility to bacterial blight; this disease was not conspicuously more in evidence than in previous seasons. MU8 is, however, a notably early cropper, one of the earliest amongst all strains grown at Samaru. The greater part of the crop from this experiment came from fruit set after the middle of October and under these conditions apparently 26C types were at a distinct advantage.

Other imported types, Uganda BP52, BAR 7/8.2, and Punjab 268F (brought in as a potential high yielder) also yielded significantly below local strains, but one Albar type (Albar 51/645) equalled 26C in yield.

District Variety Tests.

The standard series of replicated tests of promising strains at various scattered stations throughout the cotton growing areas was continued. Each of these tests is in the form of an 8 × 8 Latin square with plot size of approximately 1/80th acre, the plants being two per stand at 18″ spacing on 3 foot ridges. Most of the experiments were planted in early July, but at three sites a second test was deliberately planted several weeks later to provide a trial under conditions of delayed planting.

The seed cotton yields station by station are listed in Table 2 while Table 3 gives the combined results both as seed cotton and as ginned lint. For these combined results it was considered preferable to omit Maiduguri figures this season. The test there gave the astonishing yield, averaged over all eight strains, of approximately 1170 lb. of seed cotton per acre. It is clear that the conditions there are in some way very different indeed from those general throughout the cotton belt. As noted in previous reports the experimental farm there appears to have supplies of underground water which make it quite

TABLE 2.

DISTRICT VARIETY TESTS, SEASON 1955-56.
SEED COTTON YIELDS FROM ELEVEN EXPERIMENTS.

Experiment (with yield of control type in lb. per acre given in brackets)	*Yield of the other seven strains expressed as percentage of the control type (new issue 26C)*							S.E.
	First wave 26J	479 -25 BCP	479 -25 -44	479 -25 -97	49160 -23 BCP	26I /25	D5 /33 -4	
Samaru timely (552)	104	109	108	104	99	98	103	4·6
Samaru delayed (459)	115	116	116	105	102	116	109	6·7
Daudawa timely (236)	123	137	108	107	79	100	97	13·2
Daudawa delayed (113)	96	116	108	121	81	93	102	15·5
Gombe timely (405)	112	107	105	113	108	111	113	6·0
Gombe delayed (339)	109	111	122	99	116	115	110	5·6
Gusau (559)	101	100	100	93	88	94	88	3·8
Kano (342)	115	110	120	110	116	126	135	8·4
Kontagora (132)	101	113	111	109	103	122	116	8·7
Zonkwa (323)	103	110	98	114	106	90	86	7·1
Maiduguri (1169)	93	102	97	103	101	102	101	2·5

TABLE 3.

DISTRICT VARIETY TESTS, SEASON 1955-56.
COMBINED RESULTS FROM TEN EXPERIMENTS.

Strain	*Seed cotton yield in lb. per acre and (in brackets) as % of control type*		*Gin percent.*	*Lint yield*	*Lint length*
	(a)	*(b)*	*(c)*	*(d)*	*(e)*
New issue 26C	345 (100)	333 (100)	35·4	122 (100)	33·2
First wave 26J	374 (108)	354 (106)	34·9	131 (107)	33·6
26C/479-25 BCP	383 (111)	365 (110)	34·4	132 (108)	33·8
26C/479-25-44	377 (109)	360 (108)	36·0	136 (111)	34·4
26C/479-25-97	364 (106)	353 (106)	35·4	129 (106)	33·8
26C/49160-23 BCP	348 (101)	336 (101)	35·0	122 (100)	33·4
26I/25	366 (106)	347 (104)	36·1	132 (108)	32·7
D5/33-4	363 (105)	341 (102)	35·4	129 (106)	33·2

(a) Simple arithmetic mean of yields at ten sites.
(b) Weighted mean (yields with highest errors given least weight following Cochran's method of "Partial Weighting" Biometrics, Vol. 10, No. 1).
(c) Arithmetic mean of the separate percentages from the ten experiments: saw ginned.
(d) Pounds per acre calculated from columns (a) and (c).
(e) Millimetres, Bailey Halo, mean of 320 seeds (32 from each site).

unrepresentative of normal upland farming conditions in Northern Nigeria. It is possible that an important contribution to the cotton crop of Bornu (and perhaps Northern Kano and Katsina also) could come from such favoured patches of land but the time has not yet arrived when the variety testing programme should take them into account. It is hoped to move the Maiduguri test on to more representative land next season.

The figures set out in Table 2 show that, in spite of the usual variations from site to site with occasional really wide discrepancies, the derivatives of 26C/479, whether taken separately or combined together as "first wave 26J" have given higher yields than the control. This control was the new issue 26C stock which was shown in last season's series of tests to be an improvement on older stocks of Samaru 26C.

Comparisons of the three 26J components amongst themselves, and against the mixture of the three, show only small and inconsistent differences in seed cotton yield. The substrain 479-25-44 seems to be just appreciably better than 479-25-97 in seed cotton yield and superior to 479-25 BCP also when lint yields are considered. However, recent spinning test results (reported in the 1954-55 Progress Report) show that 479-25-44 is inferior in spinning quality to 479-25 BCP and 479-25-97, while the two latter are indistinguishable in length, hair weight and yarn strength and both a marked advance on Samaru 26C in quality.

On balance, therefore, it seems wise to discount the possibly superior yielding power of 479-25-44 and let the other two components go forward together as the new stock of Samaru 26J.

As noted earlier in this report the strain 26C/49160-23 BCP has done poorly this season compared with its promise in previous tests. It seems clearly a less consistently good yielder though its earliness and high quality merited attention. Further reselections from it may yet justify themselves.

The remaining two strains in these district tests, 26I/25 and D5/33-4, proved this season to be in no way outstanding as competitors of 26J. Both are later cropping types capable of big yields under some conditions. Their much greater variation in yield from site to site, relative to 26C and 26J, is noteworthy.

The data accumulating from these annual series of district tests are providing some most interesting sidelights on the effect of locality on crop. Each station is provided with exactly the same seed of each of the strains under test and the produce is all sent to Samaru for ginning so that within any one season valid locality comparisons are possible.

Over four seasons the figures show some consistent trends. Kano, Zonkwa, Gombe and Kontagora have tended to give longer lint than Samaru, Daudawa and Gusau. Ginning percentages have varied quite widely, tending to be higher at Samaru and Zonkwa than at Daudawa and Gombe. Maiduguri ginning percentages are strikingly low.

Small samples of seed cotton from the commercial crop obtained annually from a series of chosen markets scattered over the cotton belt are likewise showing appreciable locality effects but their full examination is not yet completed.

Maigana Cotton Variety Test.

Experiments run at Maigana in two previous seasons, as part of the series of district variety tests, gave such very poor yields and such extremely high standard errors as to provide no useful varietal comparisons. In the 1955-56 season, therefore, the experimental design was modified. Only four strains were included, chosen as likely to show the widest yield differences, and these were replicated 16 times (four 4 × 4 Latin squares, plot size 1/80th acre).

Yields were very much higher this season (the experiment was on a better drained field) but lightning struck and damaged many of the plants in nine of the plots. This damage was unequally distributed over the four strains and without some adjustment for this the yield data as a whole are of doubtful value.

Two strains, however, were damaged less severely and apparently about equally and, as it happens, these two provide a comparison of particular interest. Figures for these are, therefore presented in Table 4 below, together with a standard error calculated as though the experiment had been one of 16 randomised blocks of two strains only.

Table 4.

Data from Maigana Variety Test.
(*Yields in lb. per acre, seed cotton and lint*).

Strain	*Seed cotton*	*Gin %*	*Lint*	*Lint length*
Mai Inchi Allen	411 (100%)	31·6	130 (100%)	31·5 mm.
First wave 26J	582 (142%)	35·1	204 (157%)	33·6 mm.
S.E.	±25·3 (6·2%)		± 8·4 (6·5%)	

Seed Multiplication.

At Daudawa seed from the Samaru 1954-55 crop of Samaru 26J and its component substrains was successfully made to cover in all over 320 acres.

Two stage B areas of a nominal 20 acres each were planted, one with 479-25 BCP and one with 479-25-97. The remaining 280 acres constituted a stage C (little short of the nominal 300 acres for this stage) of first wave 26J. This was sown with mixed seed of 479-25 BCP, 479-25-44 and 479-25-97 in the ratio of 60, 20, 20.

This attempt to build up the seed of this new strain at an accelerated pace was successful. Yields were good and, with the help of contributions from plots at Samaru and Shika, approximately 39 tons of first wave Samaru 26J were produced for issue to the cultivators growing stage D in 1956-57.

The yields per acre, 590 and 570 lb. of seed cotton for the two stage B areas and 408 lb. over the stage C area, are noteworthy in view of the difficult season and reflect credit on the departmental staff at Daudawa. They also indicate that Samaru 26J can reproduce under large scale cultivation its promising behaviour displayed in small scale tests.

The bulk seed multiplication scheme at Gombe in Bauchi Province was again very successful. Sixty tons of pure stock 26C seed from Daudawa stage D were multiplied up to give more than 470 tons of seed suitable for issue to the remainder of Gombe division. The proportion of grade 3 produce (not acceptable for seed) was this season below 10% of the total crop—a big improvement on previous seasons.

Bacterial Blight (*Xanthomonas malvacearum*).

A trial of seed dressed with the mercurial disinfectant Agrosan GN5 in comparison with undressed seed was repeated with larger plots separated, this season, by 10 yard screens of guineacorn.

The behaviour of the disease, as judged by counts of plants showing symptoms, followed the course of previous seasons. A striking difference between the two treatments early in the season gradually became obscured by what appeared to be secondary spread (see Table 5). By picking time there was little visual evidence that the plants from dressed seed were in any way more free from symptoms or likely to yield more cotton. The first picking moreover did not suggest that any yield difference would be established and maintained in the final yields. The experiment was deliberately sited on weed infested land subject to severe waterlogging, and plot to plot variation within treatments was very great.

The collection of yield data from the guineacorn screens, however, enabled some adjustment to be made for this variability by a covariance analysis. The final seed cotton yields with and without this adjustment are given in Table 5.

TABLE 5.

SEED DISINFECTION TRIAL.

Counts of Infected Plants and Seed Cotton Yields of Plots Grown from Undressed (U) and Agrosan Dressed (D) Seed.

	26C			*26J*			*Means of two strains*	
	U	*D*	*Mean*	*U*	*D*	*Mean*	*U*	*D*
Counts of infected plants								
At 25 days	539	0	—	632	1	—	586	1
At 35 days	721	4	—	762	7	—	742	6
At 52 days from planting	751	59	—	765	74	—	758	67
Seed cotton yields (lb. per acre)								
First picking alone (crude)	52	59	56	49	46	48	50	52
All pickings (crude)	384	407	395	350	376	363	367 (100)	392 (106·8)
All pickings (adjusted)	347	397	372 (100)	355	417	386 (103·8)	352 (100)	407 (115·6)

The difference between the two strains in seed cotton yield is quite insignificant.
The difference between U and D means is not statistically significant but is suggestive of an effect.

From these figures it appears that the protection given to the plants by dressing the seed was sufficient to be reflected in the yields. The seed used was taken from the produce of the plots grown from undressed seed in the previous season's experiment and hence was known to be from plants which had shown considerable infection during their growth. It was lightly delinted (once through the machine) prior to dressing with Agrosan GN5 at the rate of 1:150 by weight.

Both 26C and 26J were included in the experiment. No difference in their response to seed dressing could be detected. The relative yields of the two strains are more in keeping with expectation after adjustment; a point which perhaps encourages the acceptance of the adjusted figures for the dressed versus undressed comparison as the more correct.

AGRONOMIC EXPERIMENTS.

A number of experiments concerned with cultural practices, manuring, etc., carried out at Samaru and elsewhere, largely under the control of the agronomist and in co-operation with the chemist, have cotton as the test crop. Some of the results from seven of these are briefly presented and discussed below.

The results are grouped to enable conclusions to be drawn concerning the overall effects of the various factors under trial: the full results experiment by experiment are too voluminous for inclusion here.

The design of the separate experiments followed orthodox practice for factorial experiments with plot size of approximately 1/40th acre and at least three replications of the individual treatments. Nevertheless individual results were in general of low accuracy and only the general trends brought out by combining the results are worthy of attention.

Planting Date.

Tables 6 and 7 present the results of trials of planting at various dates between 16th June and 3rd August. Plantings later than this latter date are no longer being tested, as past results have given more than adequate evidence that late August or September plantings give greatly inferior yields.

This season's results show very clearly that early July (the recommended time) was in fact the best time to plant; the rather unusual season has not proved exceptional in this respect.

Table 6.

Planting Dates of Cotton at Various Localities and Levels of Fertility

(*lb. seed cotton per acre*).

	19th June	*3rd July*	*17th July*	*31st July*	*S.E.*
Samaru high	642	641	336	273	±38·5
	(100)	(100)	(52)	(43)	(6·0)
Samaru low	446	465	257	213	±38·5
	(96)	(100)	(55)	(46)	(8·3)
Daudawa high	639	670	640	523	±45·7
	(95)	(100)	(96)	(78)	(6·8)
Daudawa low	553	604	584	433	±45·7
	(92)	(100)	(97)	(72)	(7·6)
Kontagora S high	565	450	404	284	±52·3
	(103)	(100)	(90)	(63)	(11·6)
Kontagora S low	363	376	241	280	±52·3
	(97)	(100)	(64)	(74)	(13·9)
Kontagora U	58	56	73	58	± 7·4
	(104)	(100)	(130)	(104)	(13·2)
Gombe	414	442	469	273	±52·1
	(94)	(100)	(106)	(62)	(11·8)

"High" indicates higher level of fertility (natural or induced by manuring with FYM).

"Low" indicates lower level of fertility.

"Kontagora S" indicates experiment sprayed with insecticide.

"U" indicates unsprayed.

It is clear from Table 6 that the choice of fertile land or the use of FYM does not reduce the desirability of getting the crop in during early July. The *relative* yields from the various plantings are in general quite unaffected by the fertility level. This is true also for the use of fertilisers; in general they have no substantial effect on the planting date differences.

TABLE 7.

PLANTING DATES OF COTTON WITH OR WITHOUT APPLICATIONS OF NITROGENOUS AND PHOSPHATIC FERTILIZERS

(*lb. seed cotton per acre*).

Site	*Fertilizer*	*16th June*	*8th July*	*3rd August*
Samaru	None	355 (82)	433 (100)	226 (52)
	Nitrogen	420 (80)	525 (100)	268 (51)
	Phosphate	414 (70)	593 (100)	286 (48)
	N + P	569 (80)	708 (100)	371 (52)
Daudawa	None	369 (80)	464 (100)	194 (42)
	N	583 (128)	454 (100)	243 (54)
	P	436 (76)	570 (100)	230 (40)
	N + P	544 (63)	681 (100)	202 (30)

The figures in brackets are the yields expressed as a percentage of that given by the early July planting.

TABLE 8.

NITROGEN AND PHOSPHATE APPLIED TO COTTON SEPARATELY AND IN COMBINATION

(*lb. seed cotton per acre*).

	None	*N alone*	*P alone*	*N + P*	*S.E.*
Samaru					
Kind of fertilizer	338 (100%)	405 (120)	431 (128)	549 (162)	±15·6 (4·6)
Different times of application (a)	—	450 (133)	459 (136)	579 (171)	±27·0 (8·0)
Different times of application (b)	—	406 (120)	430 (127)	563 (167)	
Different times of application (c)	—	358 (106)	404 (120)	506 (150)	
Daudawa					
Kind of fertilizer	342 (100%)	427 (125)	412 (120)	476 (139)	±25·5 (7·5)
Different times of application (a)	—	445 (130)	438 (128)	505 (148)	±44·2 (12·9)
Different times of application (b)	—	395 (115)	416 (122)	476 (139)	
Different times of application (c)	—	440 (129)	381 (111)	446 (130)	

(a) =Fertilizer applied at planting time.
(b) =Fertilizer applied at thinning time (approx. 4 weeks).
(c) =Fertilizer applied at flowering time (approx. 10 weeks from planting).

Response to fertilizer significant at each site.
Time of application not significant at either.

Fertilisers.

Table 8 gives the results of applying sulphate of ammonia and superphosphate, each alone and the two together, in experiments at Samaru and Daudawa.

The yields given by three separate planting dates have been combined in forming this table but separate figures are presented for the results obtained by applying the fertilisers at different stages in the growth of the crop. The responses which might have been obtained by applying nitrogen at one stage and phosphate at another were not tested; where N and P were applied, they were applied together.

In contrast with last season, a marked response was obtained with applications of nitrogen. The responses to N and P were additive. Although the different times of application did not give results differing statistically, a general trend in favour of the earliest possible application is apparent from the figures.

Seed Preparation.

Cotton seed in Nigeria is normally planted just as it comes from the saw gins, i.e., with the greater part of the lint removed but still carrying a heavy coat of "fuzz" or "linters". Seed with this fuzz partially or totally removed is more easily handled and germinates more rapidly and uniformly.

Results of two replicated trials comparing "raw" with machine delinted and with acid treated seed are given in Table 9. Machine delinting removes the greater part but not the whole of the fuzz, reducing the weight of the raw seed by about 7%. Treating with concentrated sulphuric acid removes all the fuzz and reduces the weight by approximately 11%.

Table 9.

Comparative Yields using Seed with or without the removal of "Fuzz" by Delinting

(*lb. seed cotton per acre in two experiments*).

	Samaru	*Daudawa*	*Combined result*
"Raw" seed (fuzz not removed)	398	561	480 (100%)
Machine delinted seed (fuzz partially removed)	405	580	493 (102·7%)
Acid treated seed (fuzz totally removed)	424	602	513 (106·9%)
Standard Error	± 14·0	± 25·1	± 14·4 (3·0)

Neither of the separate experiments nor the combined result is statistically significant but the combined result is suggestive of a real effect.

The results suggest that the removal of the fuzz coating can produce a small but appreciable yield increase—far more than sufficient to cover the cost of the process, apart from the saving in costs of handling and transport and economy of seed in planting. The more practicable process—delinting by machine—is, however, disappointing in comparison with the use of corrosive acid. Previous results in Northern Nigeria have shown that even acid treating does not always result in a measurable response. This season's results may have been in part due to the difficult growing conditions. The experiment is being repeated.

Spacing.

The conclusions to be drawn from the consistent results obtained from a series of spacing experiments at Samaru and Daudawa in previous seasons have been presented in last season's report. Similar experiments at Kontagora last season gave discordant results and further trials were, therefore, carried out at that station alone in the current season.

The results, presented in Table 13 under Insecticide Trials, do not support the tentative conclusion drawn last season that close spacing results in substantially higher yields at this station. Further examination of last season's results has indeed shown the analysis to be faulty and the conclusion invalid.

Insect Pests

BY

M. G. EMSLEY

Diparopsis watersi (*Roths.*), *Red Bollworm.*

Diparopsis watersi was the most damaging bollworm at Samaru, but the highest incidence occurred at Kontagora. Table 10 shows the totals of all bollworm larvae collected from fortnightly bud and boll samples on observation plots from early September onwards. The figures at Samaru, Kontagora and Gombe were taken from 10 × 10 yard strips planted at standard spacing of 3 feet × 18 inches. At Mokwa spacing was less regular and averaged 3 feet × 3 feet.

Three years' observations at Gombe and Kontagora have shown that populations build up from the end of September, rising to a peak of varying prominence at the end of November and declining to the beginning of January. At Gombe there was once again continuous emergence of adults from early June until late November, with a substantial peak in October.

Table 10.

Seasonal Totals of Bollworms from Crop Samples at Various Stations.

Station	*Red bollworm*	*Spiny bollworm*	*Pink bollworm*	*American bollworm*	*False codling moth*	*Not identified*
Samaru	126	17	2	—	2	—
Gombe	145	55	43	2	—	—
Kontagora	306	269	195	5	30	3
Mokwa	10	93	93	4	1	—
*Shendam	7	56	175	14	6	—
Total	594	490	508	25	39	3

*At Shendam observations were discontinued on 25th October through loss of staff.

It is interesting to note that parasitism by *Carcelia* sp. (Diptera: Tachinidae) at Gombe was completely absent this season, compared with 1·3% parasitism last year; elsewhere parasitism approximates to 20%.

Platyedra gossypiella Saund. Pink Bollworm.

Pink bollworm is not normally considered a serious pest of cotton in the main cotton growing areas but following a case of intense infestation in the Yashi district of eastern Katsina Province a brief survey was undertaken embracing Katsina and eastern Sokoto. Examination of ginnery samples and seed cotton in the official markets showed that infestation generally was only slightly above a normal year. It is now thought that this one instance was an isolated example of perhaps *fadama*† grown cotton left standing over from the previous season. It serves as a warning against inadequate enforcement of the close season; a greater effort has been made this year to ensure that the measures have been carried out. Samples from markets representative of various areas have been examined continuously throughout the season and a summary of the data appears in Table 11. It closely approximates to last year's results.

Table 11.

Pink Bollworm Larvae found in Seed Cotton Samples from Cotton Markets.

N.A. Grade	*No. of 1 lb. samples*	*Larvae inside seed*		*Larvae outside seed*		*Totals*		
		Living	*Dead*	*Living*	*Dead*	*Living*	*Dead*	*L & D*
I	55	31	46	1	20	32	66	98
II	55	34	76	4	33	38	109	147
III	49	36	91	7	28	43	119	162
Total	159	101	213	12	81	113	294	407
Number of larvae per 10 lb. sample 1955-56						7·1	18·4	25·4
Number of larvae per 10 lb. sample 1954-55						9·0	16·1	25·1

†*Fadama* (Hausa)—low-lying land subject to seasonal flooding.

Experiments on larval emergence were ruined by predacious mites which killed all the larvae between the end of March and the beginning of April.

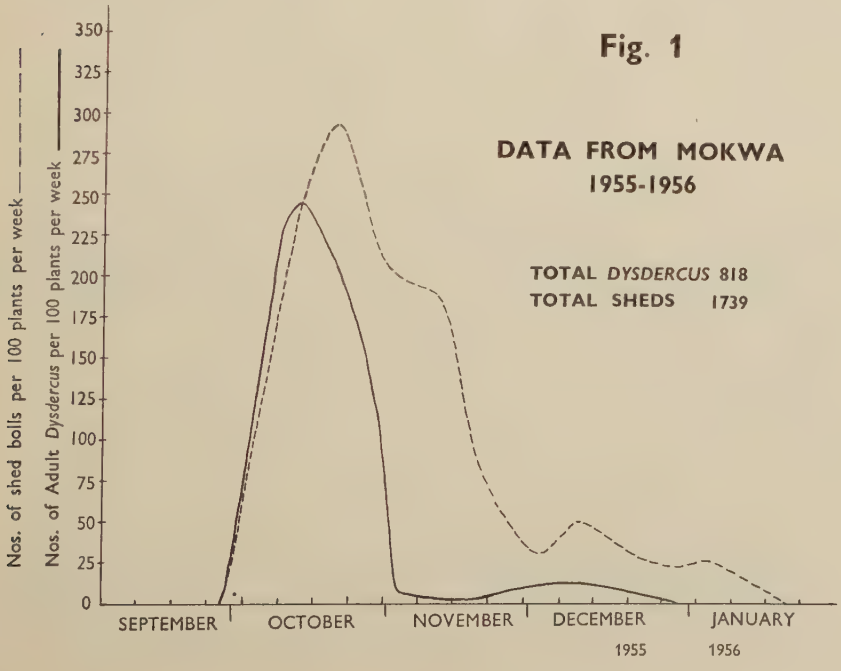
Samples from the growing crop have shown that only in the more southerly areas do the numbers reach serious proportions.

Other Bollworms.

Together with pink bollworm, both false codling moth (*Argyroploce leucotreta* Meyr.) and spiny bollworm (*Earias* sp.) are assuming greater importance with the southerly extension of the main cotton growing areas. *Earias* was most numerous on the Kontagora observation plot, and was one of the most common at Mokwa, where red bollworm appears at present to be of minor importance. *Earias, Argyroploce* and *Platyedra* all persist in the crop until harvest and are damaging bolls at a time when the plant can no longer set new fruit.

Dysdercus sp. Cotton Stainer.

The following remarks apply almost exclusively to *Dysdercus superstitiosus* F., for it is by far the more common species. *D. fasciatus* Sign. is the only other species that has been seen and then in much smaller numbers.



At Mokwa this year the bulk of the crop was lost by the excessive shedding of green bolls during the period of maximum flowering in mid October. It is well known that such shedding can take place in the absence of insects, for physiological reasons, but the coincidence of the immigration of adult stainers and the immediate increase in shedding is remarkable. Figure 1 shows the estimated stainer population and shed bolls from 2,237 carefully tagged flowers on 100 plants. It has been calculated from the tagging data that shedding most commonly takes place from between 3 and 7 days after flowering, and the time difference between the population and shedding curves is of this order. There is more than a suggestion that stainers have induced the excessive shedding; this is not a new idea but hitherto substantial evidence has been lacking from this area. A somewhat similar situation appeared at Gombe, but at Samaru the stainer level was so low that no correlation with shedding could be made.

The study of the alternative host trees upon which stainers are known to feed has been carried out for some years now, but there are still very few records of stainers being present on any of them from late December, when they leave the cotton crop, until late February and March when the adults appear suddenly in large numbers on such trees as *Bombax* (Kapok) and *Ceiba* (Silk Cotton). Migration on to *Adansonia* (Baobab) does not normally occur until May. A small number of stainers can be found in January hidden away under vegetable debris and in cracks in the ground, but these alone cannot account for the large numbers of adults that there must be to infest the alternative hosts in March.

Mirids.

The biology of the Miridae infesting cotton is one of the main items on next season's programme. Preliminary collections have yielded numerous genera of which the following have been identified by the British Museum (Nat. Hist.), London: *Lygus vosseleri* Popp., *Megacoelum* sp., *Eurystylus* sp., *Stenotus* sp., *Deraeocoris* sp., and at least three species of *Campylomma.*

Tattering, attributed to mirids, was generally moderate with locally severe, or very severe patches.

Crop Development.

Flower tagging has been carried out at Kontagora, Mokwa, Gombe and Samaru. Observations at Shendam had to be discontinued owing to staff difficulties. At each locality 10 randomly disposed strips are allocated at planting, each strip containing 10 plants, making a total of

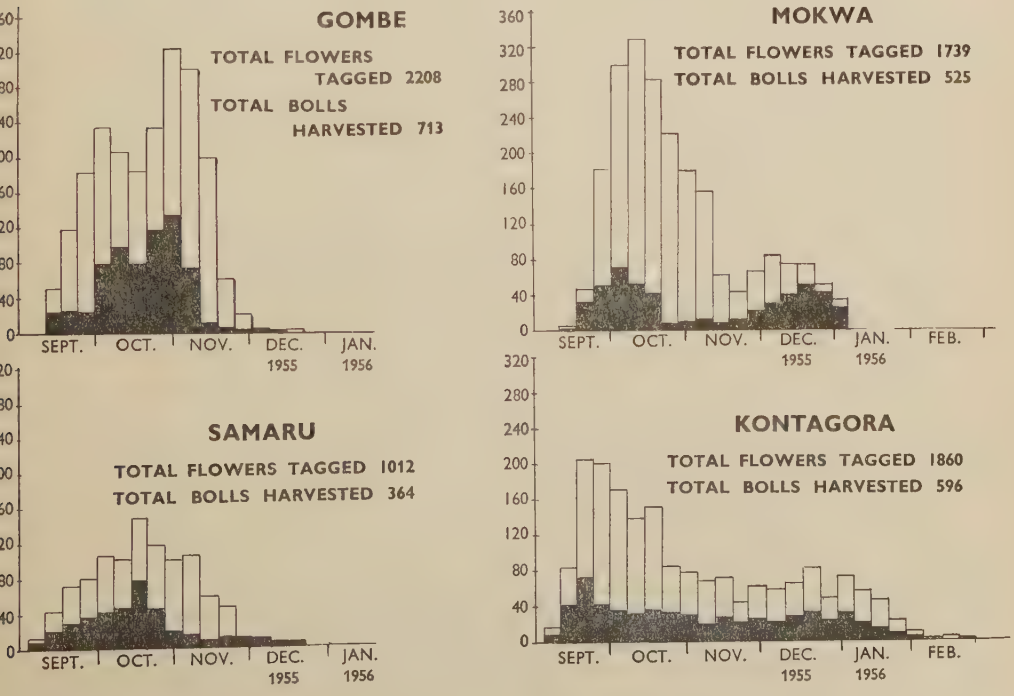
100 plants tagged at each station. All the flowers are tagged as they open and their subsequent fate recorded in a ledger, and classified into aborted, shed or harvested, and into clean and damaged (bollworm and non-bollworm). This provides a wealth of fundamental data that can be related to pest records.

The main shortcoming of this method is that with the assistants available it is impossible to study initiation of buds, because of their small size. It is believed that many phytophagous, as well as sap-sucking insects, feed on buds, in which case the flowering curves obtained may differ markedly from the flowering potential in the absence of insects.

As an example of the type of information derived from tagging data, Figure 2 shows the derivation of the harvested cotton at each of the outstations.

Fig. 2

White Histogram shows the number of flowers opening each week. Black Histogram shows the number of flowers that produced bolls that were harvestable. Records were taken from 100 plants at each station.



Insecticide Trials.

BY

M. A. CHOYCE

Samaru.

(a) In the Progress Report for 1954-55 it was suggested that damage by pests to bolls retained on the plant reduced yield by about 25%. This was assumed to be the greater part of the total loss in yield in seasons when shedding induced by insects was to a large extent compensated for by the plant, as shown by the absence of significant increases in yield following the application of insecticides designed chiefly to reduce shedding.

In seasons when pest incidence is high, or when there is a moderate pest attack on cotton which has low compensatory powers, insect-induced shedding will cause additional crop losses. In these cases it might be possible, with insecticides, to reduce pest incidence to a level at which the physiological shedding is dominant, without the necessity for complete control of pests concerned. Suitable observations on the crop would then enable a reasonable estimation of losses due to insect pests to be made.

A preliminary trial to test this assumption was laid down at Samaru on cotton sown on 25th June in plots of 390 sq. yds., with discards 5 yards wide between and surrounding all plots. There were six replications of the following treatments:—

A—DDT/BHC spray: 2 lb. DDT and 0·6 lb. gamma BHC/acre.
B—Dieldrin spray: 0·47 lb. Dieldrin/acre.
C—Control.

The sprays were applied on 5th October, 19th October, 2nd November and 15th November at the rate of approximately 25 gallons per acre, using knapsack sprayers.

Picking began at the end of November and continued until the first week of January. Final yields of unsorted seed cotton were:—

A—564 lb./acre (150%)**
B—489 lb./acre (130%)*
C—377 lb./acre (100%)
S.E. 32 (8·5%)
Coeff. of Variation: 16·3%

Basing calculations on the yield of treatment A, and making allowance for loss in weight of damaged seed cotton, the possible yield in the absence of pests under the conditions of the experiment would

Table 12.

Seed Treatment Trial, using Gamma BHC and Agrosan GN5: Summary of Results.

Seed treatment: Gamma BHC W/W	1:1000	1:2000	1:4000	1:1000	1:2000	1:4000	1:1000	1:2000	1:4000	Nil	Nil	Nil
Seed treatment: Agrosan GN5 W/W	Nil	Nil	Nil	1:150	1:150	1:150	1:300	1:300	1:300	1:150	1:300	Nil
Percentage stands germinated on 14th July	93·7	94·6	93·8	93·8	87·1	90·0	91·7	91·7	96·2	91·7	93·3	99·8
Percentage stands germinated on 22nd July	66·0	63·1	62·6	67·0	66·7	66·3	67·7	67·1	71·0	69·0	69·8	62·2
Mean plant height in inches on 10th August	5·3	5·1	5·1	4·6	4·9	5·0	5·1	5·0	5·5	5·1	5·3	5·0
Mean plant height in inches on 26th August	6·7	6·8	6·9	6·3	6·5	6·4	6·5	6·5	6·9	6·5	7·0	6·4
Percentage of stands with active bacterial blight: on 16th August	3·1	3·7	7·7	0·0	0·0	0·0	0·0	0·2	0·0	0·0	0·2	4·3
Percentage of stands with active bacterial blight: on 31st August	10·1	7·6	23·4	1·1	1·7	2·1	2·9	1·5	1·1	1·8	3·6	12·1
Percentage of stands with active bacterial blight: on 19th September	22·2	23·4	24·2	15·5	12·7	17·0	15·3	17·0	7·4	8·5	12·5	25·2
Weight (lb.) of 100 seedlings thinned on 11th August	0·44	0·40	0·44	0·37	0·39	0·33	0·41	0·39	0·41	0·40	0·41	0·38
Percentage of plants with distorted roots (early December)	9·1	13·1	17·3	9·2	13·0	13·5	15·4	9·8	11·3	6·6	18·25	23·4
Yields—Lb. seed cotton per acre	272	214	283	273	301	282	281	297	294	273	259	285
Difference from control	−13	−71	−2	−12	+16	−3	−4	+12	+9	−12	−26	

have been 665 lb. seed cotton per acre. As the control plots yielded 377 lb. per acre, loss due to pests was 43%. Additional observations show that of this loss 34% could be attributed to shedding and 9% to damage to split bolls.

The significant increase following the use of insecticides on cotton at Samaru this season is probably related to the difficult growing conditions mentioned in the Introduction (page 1). In another experiment, application of DDT/BHC spray (3 lb. DDT and 1 lb. gamma BHC per acre) on 29th September, 13th October, 27th October and 10th November increased yields by 56%:

Mean yield of 8 sprayed plots: 583 lb. seed cotton per acre.
Mean yield of 24 untreated plots: 374 lb. seed cotton per acre.

(b) A replicated trial to determine whether the application of alphanaphthalacetic acid would increase yield, by causing buds that would otherwise shed to remain on the plant, was carried out on cotton sown on 5th July. Plot size was 4 ridges × 12 yards, the two centre ridges of treated plots receiving 1 gallon of a solution containing 10 ppm alphanaphthalacetic acid. Applications were made on 22nd September, 29th September, 14th October, 29th October and 10th November.

The treatment did not result in any increase in yield, the mean yield of 16 treated plots being 369 lb. seed cotton per acre, compared with 374 lb. per acre from 24 control plots.

(c) The results of a trial using gamma BHC alone and in combination with Agrosan GN5 as a seed dressing are shown in Table 12. There were six replications of twelve treatments on plots of 4 ridges × 12 yards. The seed used was raw 26C, which was sown on 7th July on a site that had lain fallow for some years. Superphosphate at 44 lb. per acre was applied on 22nd July. Agrocide 15W was used as the source of gamma BHC.

At the rates used, BHC did not prevent development of bacterial blight in the early stages of growth; this disease was controlled by Agrosan GN5 up to late August, after which there was a general spread throughout all plots. The final overall yield from the trial was low and treatment differences were not significant.

There is a suggestion that some of the treatments have reduced the number of plants with distorted roots. This distortion was noticed during the course of uprooting at the end of last season; in extreme cases there was excessive bifurcation and contortion of the taproot. Subsequently the roots of the plants in the Samaru date of sowing, spacing and manurial trial were examined; though there was much variation within blocks and treatments, no regular pattern of variation was obvious. This phenomenon is apparently similar to that reported from North Carolina * with an equally vague origin.

*Moore, R. P. "The Case of the Missing Taproot." Crops and Soils, 1956, *8*, No. 4, Jan., p. 19.

TABLE 13.

SPRAYED AND UNSPRAYED TRIALS OF COTTON AT KONTAGORA AT VARIOUS PLANTING DATES AND SPACINGS, MANURED AND UNMANURED

(*lb. seed cotton per acre*).

		Manured				*Unmanured*				
		9″	18″	27″	*Mean*	9″	18″	27″	*Mean*	*Grand Mean*
19th June	Sprayed	612	553	529	565	343	376	370	363	464
	Unsprayed	48	59	48	52	65	65	61	64	58
3rd July	Sprayed	435	519	396	450	392	322	414	376	413
	Unsprayed	41	36	38	38	76	80	62	73	56
17th July	Sprayed	449	405	358	404	242	252	232	242	323
	Unsprayed	64	58	63	62	85	80	88	84	73
31st July	Sprayed	286	296	271	284	281	274	284	280	282
	Unsprayed	53	51	48	51	65	61	70	65	58
Mean	Sprayed	446	443	388	426	314	306	325	315	370
	Unsprayed	52	51	49	51	73	72	70	72	61

Manured plots received 3 tons of FYM per acre.

Kontagora.

Last year's experiment in which a complete date of sowing, spacing and manurial trial of cotton was regularly sprayed during the season, for comparison with an unsprayed trial, was repeated.

The dates of sowing this year were 19th June, 3rd July, 17th July, and 31st July.

Spray (2 lb. DDT and 0·6 lb. gamma BHC per acre) was applied at fortnightly intervals. 9 applications, beginning on 10th August, were made on the 19th June sowing. Numbers of sprays were reduced on later sowings, that of 31st July receiving 6 applications, beginning from 21st September.

A summary of results is shown in Table 13. The sprayed trial showed an overall increase in yield of just over 500% of the yield of the unsprayed trial. In neither trial is there any significant difference in the yields from different spacings.

Appendix.

Origin and Main Characteristics of Cotton Strains Mentioned in this Report.

Allen or Nigerian Allen	"Allen's Long Staple", together with a number of contemporaneous strains of American Upland origin, was introduced into N. Nigeria in 1912 from East Africa. The present "Allen" is the result of growing the produce of this introduction successively for some 44 generations, exposed to admixture with other strains under trial and with the locally grown *Gossypium hirsutum* var. *punctatum*. Its present staple length is a bare 1″ on universal standards.
Mai Inchi Allen	The commercial stock of Allen being grown in Mai Inchi ginnery area (Western Sokoto Province) in 1951-52 prior to the replacement of Allen by Samaru 26C. Since maintained at Samaru as a representative Allen stock.
Samaru 26C	A selection from Allen originating from work commenced in 1931 and emerging as a recognised improved strain in 1939. Notable for its higher yield, higher ginning percentage and relative freedom from "nep".
26C New Nucleus Stock	The result of bulking seed from 66 chosen progenies grown from representative single plant selections taken from 26C in 1949. Issued for multiplication in 1951.
26C New Issue	A blend of 50% new nucleus stock with 50% of a mixture of three chosen 26C reselections (each of proved good field performance and spinning quality) 26C/479-25 26C/49160-23 26C/49197
26J	A derivative of 26C obtained by straight reselection commenced in 1947, being material from the line 26C/479-25. Higher yielding and earlier cropping than 26C with higher spinning quality.
First Wave 26J	60% 479-25 BCP. 20% 479-25-44. 20% 479-25-97.
Second Wave 26J	50% 479-25 BCP. 50% 479-25-97.
26C/479-25 479-25 BCP 479-25-44 479-25-97	Closely related derivatives of 26C/479 together forming the components of 26J.
26C/49160-23 49160-23 BCP	A derivative from 26C originating from a single plant selection made in 1949. High yield, early cropping, higher spinning quality.
26I/25	26I was a sister strain of 26C dating back to 1938; 26I/25 is a recent derivative.
D5/33-4	D5 was an intermediate step in the derivation of 26C from Allen; D5/33-4 is a reselection.

Imported Types (obtained for trial or use in breeding work).

Uganda BP52	A high quality strain from Uganda.
BAR 7/8.2	A Sudan strain bred from SP84 which was a Uganda derivative of Parnell's U4.
Punjab 268F	A strain of American Upland giving high yields in the Punjab.
MU8A	A Malwa Upland strain from India; early and prolific but of low ginning percentage and quality.

Received November 1956.

Printed by T. Buncle & Co. Ltd., Arbroath.